II. REMARKS

In the most recent Office Action dated April 6, 2005, the Examiner rejected claims 3-8, 10 and 12-16 under 35 U.S.C. § 112 ¶ 1, again stating that it was unclear from the specification how the receiver could determine the intensity of the signal. Particularly, he inquired as to what structure has been added to the receiver to permit it to recognize different signal strengths.

In response, Applicant contends that one of ordinary skill in the art, given the information in the specification, should be able to practice the invention. Applicant again refers to the declaration of the inventor Simo Maenpaa and in particular to the master's thesis of Pasi Mattila referred to and incorporated in that declaration. A translation of relevant portions of that thesis is attached. While the thesis discusses relevant electromagnetic field intensity theory, it also discusses and illustrates application of that theory and particularly its application to heart rate monitors of the type described in the application. Section 2.2.1 explains how the mutual inductance between a coil in the transmitter worn by a runner on the treadmill and a coil in the receiver depends upon the distance between the two coils. Section 2.2.2 describes how the analog signal and a polar heart rate receiver will vary as a function of distance from the transmitter. That signal can be measured with an oscilloscope at the test point indicated in Figure 2.5. Accordingly, it can be seen that the variation signal strength, and therefore the variation in field intensity, can be measured directly from the receiver without any modification of the receiver itself. In other words, the information can be obtained directly from the heart rate signal detected by the receiver. Accordingly, both this theory and the application of the theory to heart rate monitors in the subject invention are know in the prior art and should be apparent to someone of ordinary skill in the art.

Secondly, the Examiner rejected Claims 10 and 12-16 under 35 U.S.C. § 112 ¶ 1, as failing to comply with the written description requirement. Particularly, the Examiner alleged that the

application does not contain structural recitations of the claimed amplifier, filter and signal modifier. In response Applicant again refers to the Maenpaa declaration and in particular the Mattila master's thesis §§ 2.2.2 and 2.2.3 (attached). As explained in the thesis, the analog signal from the heart rate monitor inherently varies as a function of the distance between the transmitter and receiver. These changes can be detected with an oscilloscope at the test point indicated in Figure 2.5. In connection with the invention, of course, the oscilloscope is not utilized but the signal is simply amplified, filtered, transmitted to the user interface processor and digitized. As explained in the thesis the digital signal obtained also varies as a function of the distance between the transmitter and the receiver. An important aspect of this invention is that although the signal has previously been used for other functions, its distant dependent features have not previously been used to control the endless belt. As stated in his declaration, Applicant believes that in view of the thesis and the information given in the application regarding signal processing, one of ordinary skill in the art could well understand the invention and select appropriate electronic components in the building of an embodiment.

Further, the Examiner rejected Claims 3-8, 10 and 12-16 as being anticipated by *Huish et al.* or *Trulaske et al.* He pointed out that when the user is beyond the range of the receiver of either of these references, no signal is received so the receiver is necessarily sensitive to the position of the user on the belt. Therefore the receiver is responsive to the position of the user on the belt. The treadmill apparatus according to Claim 3 now includes (1) means for receiving an electromagnetic signal, which means has a predetermined operating range and (2) means attachable to a treadmill user for generating an electromagnetic signal having a field strength variable within the operating range of the receiving means. Similarly, the invention now claimed in independent Claim 10 includes (1) a receiver for receiving an electromagnetic signal, the receiver having a predetermined

operating range and (2) a transmitter . . . for generating an electromagnetic signal having a field strength variable within the operating range. As with Claim 3 neither *Huish* nor *Trulaske* disclose or suggest such a treadmill apparatus.

The Examiner also rejected Claims 3-8, 10 and 12-16 as being obvious over *Huish* or *Trulaske* in view of *Shyu*. *Shyu* discloses means for detecting the position of a user on a treadmill including a transmitter for transmitting an ultrasonic wave toward the user and a receiver for detecting the wave when it is reflected from the chest of the user. Nowhere does *Shyu* disclose or suggest means for detecting field strength of an electromagnetic wave transmitted from a transmitter attachable to the user, means for detecting the field strength of the transmitted wave, or means for producing a control signal responsive to the field strength. Accordingly, Applicant contends that the invention according to independent Claim 10 would not be obvious in view of any combination of the teachings of *Huish, Trulaske* and/or *Shyu.*

Finally, the Examiner has rejected Claims 3-8, 10 and 12-16 as being obvious over *Potash et al.* in view of *Huish* or *Trulaske*. *Potash* discloses a treadmill in which information from an ultrasonic transmitter/receiver mounted to the treadmill frame is used to calculate the position of the user on the treadmill. It also includes means responsive to this position information for varying the speed of the treadmill in order to maintain the user in a predetermined position on the belt. Applicant would show that there are no teachings in *Potash* and, as stated above, in *Huish* or *Trulaske*, that would disclose or suggest a treadmill as now claimed according to independent Claims 3 or 10.

In each of the above rejections based on prior art, the rejection of Claim 16 is moot as it has been cancelled.

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In summary, the Applicant believes that none of the references cited by the Examiner, either singularly or in combination, disclose or suggest the invention now claimed and that the invention is patentable over all prior art cited by the Examiner or known to the Applicant. Accordingly, the Applicant requests that the Examiner re-examine this application in view of the above amendments and remarks, withdraw all rejections and objections of record, and allow each of the claims now proposed.

In the event additional fees are due as a result of this amendment, payment for those fees has been enclosed in the form of a check. Should further payment be required to cover such fees you are hereby authorized to charge such payment to Deposit Account No. 501050.

DATED this 6th day of October, 2005.

Respectfully submitted,

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Attachment: Translated portions of Pasi Mattila's Master's Thesis

CERTIFICATE OF MAILING

I hereby certify that this correspondence (together with all attachments and enclosures) is being deposited with the United States Postal Service with sufficient postage as first class mail in an envelope addressed to Box Fee Amendments, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Dated: October 6, 2005

Erin L. Barr

Signature

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The following part is translated from Pasi Mattila's master's thesis "Käyttäjän paikkaan perustuva juoksumaton nopeuden ohjausjärjestely" which was approved 8th of October 2001 by the physics department of the University of Turku (http://www.physics.utu.fi/opiskelu/opinnaytteet2001.html).
This technique is used in the treadmill models T60-T90 manufactured by Tunturi (http://www.tunturi.com/fitness/treadmills.cfm)

2.2 THE HEART RATE RECEIVER SIGNAL STRENGTH AS A FUNCTION OF THE DISTANCE BETWEEN TRANSMITTER AND RECEIVER

2.2.1 MAGNETIC FIELD BETWEEN TWO COILS

The heart rate signal is sent from the transmitter to the receiver using an electromagnetic field. The electromagnetic field is created by a coil in the transmitter and it is detected by a coil in the receiver. The changes in the electromagnetic field (and thus signal strength) as a function of the distance can be examined through two inductive coupled current circuits.

The magnetic flux Φ flowing through a current circuit is proportional to the current

$$\Phi = LI \qquad (1)$$

Factor L is called the inductance. If a wire is twisted to a multiple turn coil, the flux is increased as a function of the turns. The flux of the coil Ψ can be determined by adding all loops together

$$\Psi = \Phi_1 + \Phi_2 + \ldots + \Phi_n \qquad (2)$$

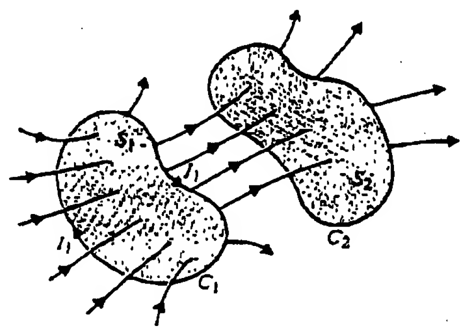
Φ_n = the flux flowing through loop n

The inductance of the coil is determined as

$$L = \frac{\Psi}{I} \qquad (3)$$

Let's take two wireloops C_1 ja C_2, which bound surfaces S_1 and S_2 respectively. If current I_1 runs through C_1, a magnetic field B_1 is created. A part of the flux created by the magnetic field goes through the surface S_2 which is bound by a wire C_2 (picture 2.3). Let this flux be Φ_{12}. Then [11,p. 267]

$$\Phi_{12} = \int_{S_2} \boldsymbol{B}_1 \cdot d\boldsymbol{s}_2 \qquad (4)$$



Picture 2.3. Two inductively coupled loops. [11,p. 267]

From Biot-Savart law [11, p.235]

$$\boldsymbol{B} = \frac{\mu_0 I}{4\pi} \oint_C \frac{d\boldsymbol{l} \times \boldsymbol{a}_R}{R^2} \qquad (5)$$

($\boldsymbol{a}_R$ is a unit vector from the source to the field point and $d\boldsymbol{l}$ is infinitesimal length of conductor carrying electric current) can be seen that $\boldsymbol{B}_1$ is directly related to current I_1.

Let's say

$$\Phi_{12} = L_{12} I_1 \qquad (6)$$

where coefficient L_{12} is the mutual inductance between loops C_1 and C_2. If C_2 concists of N_2 turns, we can wrote [11, p.267]

$$L_{12} = \frac{N_2 \Phi_{12}}{I_1} \qquad (7)$$

From (5) and (7) we get [11, p.274]

$$L_{12} = \frac{N_2}{I_1} \int_{S_2} \boldsymbol{B}_1 \cdot d\boldsymbol{s}_2 \qquad (8)$$

If $\boldsymbol{B}_1$ is determined by the vector potential of the magnetic field $\boldsymbol{A}_1$ [11, p.274]

$$\boldsymbol{B}_1 = \nabla \times \boldsymbol{A}_1 \qquad (9)$$

we get

$$L_{12} = \frac{N_2}{I_1} \int_{S_2} (\nabla \times \boldsymbol{A}_1) \cdot d\boldsymbol{s}_2 = \frac{N_2}{I_1} \oint_{C_2} \boldsymbol{A}_1 \cdot d\boldsymbol{l}_2 \qquad (10)$$

In case of current carrying wire[11, p..234]

$$\boldsymbol{A}_1 = \frac{\mu_0 N_1 I_1}{4\pi} \oint_{C_1} \frac{d\boldsymbol{l}_1}{R} \qquad (11)$$

With equations (10) and (11) integration is done only once over loops C_1 and C_2. Multiple turns have counted with coefficients N_1 and N_2. If we substitute (11) to equation (10) we get [11, p.274]

$$L_{12} = \frac{\mu_0 N_1 N_2}{4\pi} \oint_{C_1} \oint_{C_2} \frac{d\boldsymbol{l}_1 \cdot d\boldsymbol{l}_2}{R} \qquad (12)$$

where R is the distance between infinitesimal lengths $d\boldsymbol{l}_1$ and $d\boldsymbol{l}_2$.

If coefficients N_1 and N_2 are included to the integrals (C_1 is the route, which goes through every loop included in N_1, and C_2 goes through every loop included in N_2 respectively) we get Neumann equation[11,p.274]

$$L_{12} = \frac{\mu_0}{4\pi} \oint_{C_1} \oint_{C_2} \frac{d\boldsymbol{l}_1 \cdot d\boldsymbol{l}_2}{R} \qquad (13)$$

We notice that the mutual inductance is inversely proportional to the distance between the two coils. The Neumann equation is symmetrical with respect to indexes 1 and 2. From this symmetry follows that the mutual inductance is equal from coil to coil regardless of the coil shape [12, p.251]

$$M = L_{12} = L_{21} \qquad (14)$$

A coefficient of coupling can be determined as [12, p.337]

$$k = \frac{M}{\sqrt{L_1 L_2}} \qquad (15)$$

If coils have a common ironcore, coefficient is close to 1. With air filled core coefficient is smaller and if the distance between the coils is increased, the coefficient decreases. In oscillation circuits (common in RF technology) for signal processing coils with very small coupling coefficient is used.[12, p.338]

If current I_1 changes, a voltage will be induced to C_2. According to Faraday's law the voltage is [11, p. 310]

$$e = -\frac{d\Phi}{dt} = -L_{12}\frac{dI}{dt} \qquad (16)$$

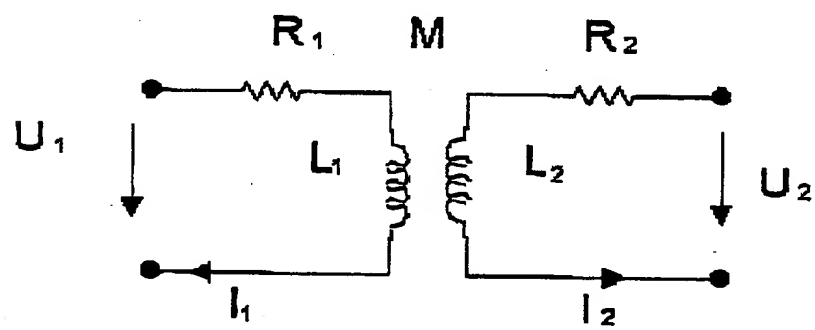
Minus sign comes from Lenz's law: the current in the loop flows in such a way that it tries to sustain the magnetic field. [11, p. 310]

Picture 2.4 shows the capacitances, resistances, currents and voltages, which are included in inductive coupling. M is the mutual inductance between the two coils. When positive directions are chosen symmetrically, voltage equations are [12, p. 336]

$$U_1 = R_1 I_1 + L_1\frac{dI_1}{dt} + M\frac{dI_2}{dt} \qquad (17)$$

$$U_2 = M\frac{dI_1}{dt} + R_2 I_2 + L_2\frac{dI_2}{dt} \qquad (18)$$

L_1 and L_2 are the self inductances of the coils 1 and 2.

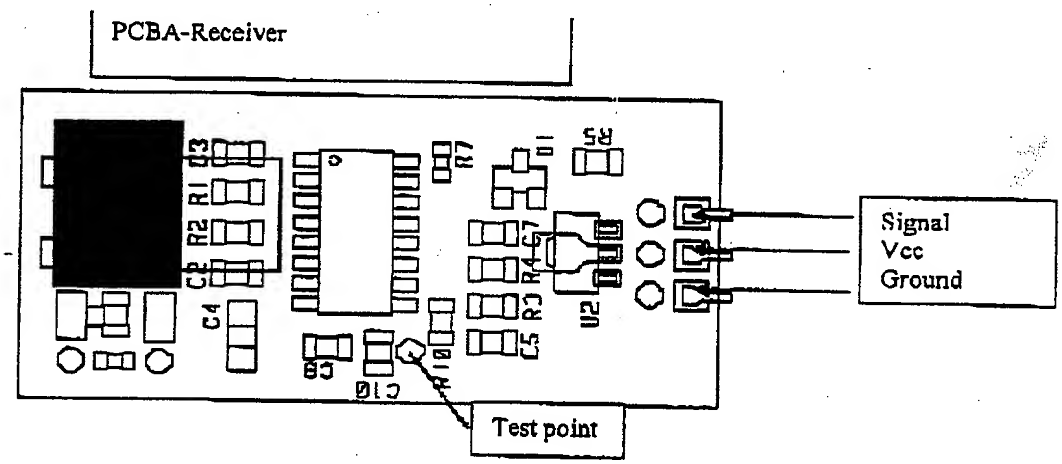


Picture 2.4. The capacitances, resistances, currents and voltages, which are included in inductive coupling of two coils. [12, p. 336]

We can think that in the picture 2.4 the left side represents heart rate transmitter and the right side heart rate receiver. From the equation (18) we see that the right side connects to the left side through mutual inductance M and the mutual inductance depends on the distance between these two coils (equations (13) and (14)). This phenomen is the theoretical base for the position speed control and practical measurements are described in sections 2.2.2-2.3.2.

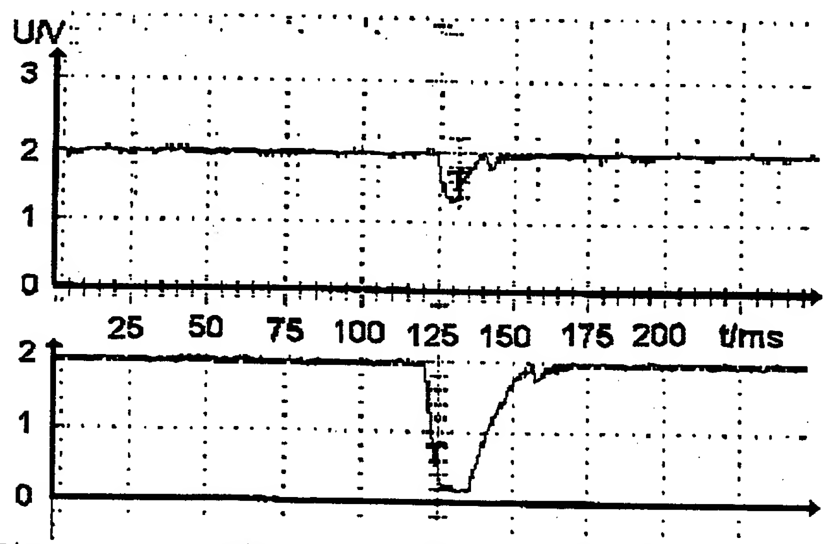
2.2.2 THE ANALOG SIGNAL

From the heart receiver test point (picture 2.5) we can measure the changes in analog signal in function of the distance with an oscilloscope. The base level for an undisturbed signal is about +2V. The heart beat information coming from the transmitter is shown as a temporary (about 8 – 35 milliseconds) voltage drop. When transmitter comes closer to the receiver, the drop gets deeper and lasts longer.



Picture 2.5. Polar Heart rate receiver [10]

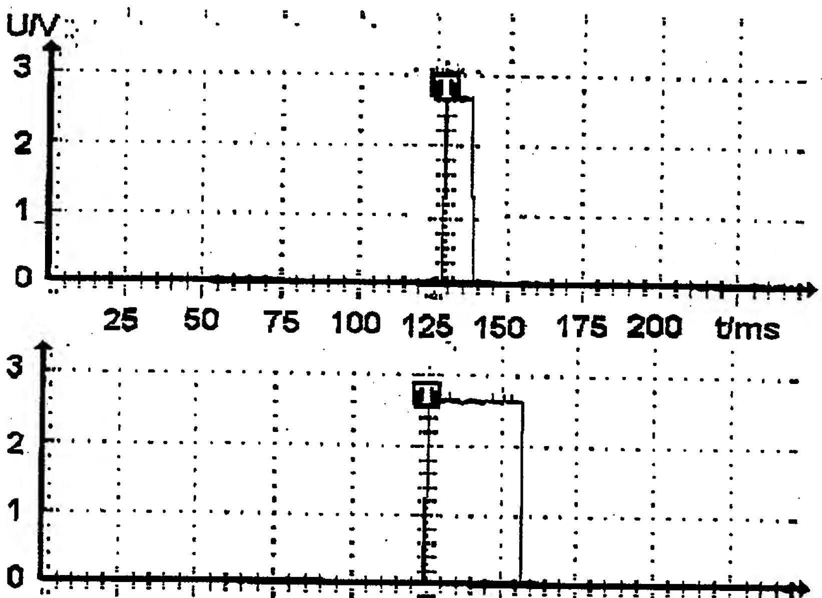
When transmitter and receiver are close to each other the minimum voltage is about 30-50 mV and when the distance is stretched to the reception range limit the minimum is about 1200 – 1400 mV. The picture 2.6 is taken from the oscilloscope. The lower graph represents a signal with distance 10 cm between transmitter and receiver. The upper graph shows the signal when the distance is 100 cm. The y-axis resolution is 1 V/div and x-axis 25 ms/div.



Picture 2.6. An oscilloscope picture of the analog signal. The lower graph is taken with transmission distance 10 cm and upper with 100 cm..

2.2.3 THE DIGITAL SIGNAL

The digital signal (the "signal" in picture 2.5, this goes to the user interface microprocessor) is generated with a level sensitive triggering from the analog signal, so it is obvious that this signal is also changing as function of the distance between the transmitter and the receiver. When transmitter is close to the receiver, signal length is 30-35 ms. When the distance is stretched to the reception range limit the signal length is 5-8 ms. In the picture 2.7 the lower graph represents the digital signal when the distance is 10 cm and the upper graph with distance 100 cm.



Picture 2.7. An oscilloscope picture of the digital signal. The lower graph with distance 10 cm and the upper with 100 cm. Y-axis resolution is 1 V/div and x-axis 25 ms/div.

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